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ILLUSTRATIONS OF FUNGI—XX

WILLIAM A. MURRILL

Most of the illustrations on the accompanying plate were drawn from specimens collected in or near the New York Botanical Garden. Two of them, figures 3 and 5, were copied from studies by Mr. George E. Morris. *Clitocybe illudens* is distinctly poisonous, but easily recognized; *Collybia platyphylla* is edible, but of little importance as food.

Clitocybe illudens (Schw.) Sacc.

DECEIVING CLITOCYBE. JACK-MY-LANTERN

Plate 158. Figure 1. × 1

Pileus convex to plane or depressed, irregular, often umbonate, densely cespitose, 10–20 cm. broad; surface glabrous, saffron-yellow; context thick, white or yellowish becoming sordid with age, the odor agreeable and the taste not characteristic; lamellae broad, decurrent, saffron-yellow; spores abundant, globose, hyaline, 4–5 μ; stipe long, firm, glabrous, concolorous, tapering toward the base of the cluster.

This species is readily recognized by its large size and brilliant coloring. It occurs throughout the eastern United States from midsummer to autumn in large clusters about dying trunks and stumps of deciduous trees. On dark nights, these clusters and also pieces of dead wood containing the mycelium are usually conspicuously phosphorescent. The plant is distinctly poisonous,

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showing a muscarin reaction on the nerves of the heart, and producing nausea, vomiting, and diarrhea. An article on the poisonous properties of this interesting species appeared in *Mycologia* for July, 1913.

Hypholoma lacrymabundum (Bull.) Quél.

WEEPING HYPHOLOMA

Plate 158. Figure 2. × 1

Pileus rather fleshy, ovoid to expanded, sometimes broadly umbonate, solitary or cespitose, 5–8 cm. broad; surface fulvous to isabelline with intermediate shades, darker on the umbo, covered when young with appressed, matted fibers, which may disappear with age or collect into small squamules, the cuticle cracking areolately at times, margin not striate; context very thin, concolorous, the taste mild or slightly disagreeable, the odor not characteristic; lamellae rather crowded, sinuate-adnexed or adnate, somewhat ventricose, yellowish, shading to umber and spotted with black and rusty-brown as the spores mature, whitish on the edges; spores nearly lemon-shaped, apiculate, opaque, tuberculose, very dark brown under the microscope, black in mass, 8–10 × 4–6 μ; cysidia abundant, 40 × 9 μ; stipe equal or slightly enlarged below, subconcolorous, nearly white at the apex, hollow, 5–10 cm. long, 8–12 mm. thick; veil of whitish, fibrous tufts adhering partly to the margin and partly to the stipe.

This species is not uncommon in many parts of the eastern United States and Europe, in grass or weeds in the open or among leaves or about old stumps in thin woods, appearing from the middle of June to October in this latitude. It comes up regularly on my lawn each year, sometimes solitary and sometimes in dense clusters, but always attractive because of its splendid coloring and its peculiar "weeping" character. Its surface characters vary considerably with age and weather conditions. I have not tested its edibility.

The history of this species is rather confusing. It was originally described by Bulliard as *Agaricus lacrymabundus* and figured by him and by Sowerby. Persoon gave it a new name, *Agaricus velutinus,* which Fries reduced to a variety when he took up Bulliard's name, but later, in figuring the species, Fries emphasized

the squamulose character often seen in large, old plants rather than the more usual appressed-fibrillose character of the surface. While the two specific names above cited refer to the same thing historically, they have been used in this country to distinguish the squamulose specimens of this group from the fibrillose or velvety ones. There is no doubt that we have in America some varieties or species not represented in Europe, all with the peculiar, opaque, tuberculose, lemon-shaped spores. Peck's key to these is given here for the convenience of collectors. The different generic names that have been assigned to this group need not be discussed at present.

PECK'S KEY TO HYPHOLOMA § VELUTINA

Pileus persistently hairy-sqamulose or fibrillose.	
Hymenophore cespitose; spores 8–10 × 5–6 μ.	1. *H. lacrymabundum.*
Hymenophore gregarious; spores 10–12 × 6–8 μ.	2. *H. rigidipes.*
Pileus partly or wholly glabrous.	
Pileus smooth, the cuticle often rimose.	3. *H. Boughtoni.*
Pileus rugose or radiately wrinkled.	
Pileus tawny; spores rough.	4. *H. rugocephalum.*
Pileus brown; spores smooth.	5. *H. delineatum.*

Mycena pura (Pers.) Quél.

PURE MYCENA

Plate 158. Figure 3. × 1

Pileus fleshy, thin, campanulate or convex to expanded, obtusely umbonate when young, 2–5 cm. broad; surface smooth, glabrous, of uniform color, varying from rose to rose-purple, violet, or lilac, margin striate, upturned with age; lamellae rather broad, adnate to sinuate, sometimes wavy and crenate on the edges, venose-connected, varying from white to shades of rose or violet, sometimes white on the edges; spores oblong, hyaline, 6–8 × 3–3.5 μ; stipe firm, smooth subglabrous, concolorous, hollow, somewhat villose at the base, 5–8 cm. long, 2–4 mm. thick.

This beautiful little species is common on the ground in woods throughout temperate North America and Europe. It varies considerably in shape, sometimes being small and bell-shaped with a long stipe and at other times being quite broad and from convex to plane with a short stipe. An old French chart includes

it among the dangerous species, but its properties have probably not been thoroughly investigated. Even if harmless, it is too small and thin to be considered for food. The color varieties of this species had already received several specific names before Persoon grouped them under *Agaricus purus*.

Collybia platyphylla (Fries) Quél.

BROAD-GILLED COLLYBIA

Plate 158. Figure 4. × 1

Pileus large, thin, fragile, convex to expanded, 8–15 cm. broad; surface whitish to grayish-brown or dark-brown, at times darker on the disk, innately fibrillose to subglabrous, margin often upturned with age; context white, sometimes with a faint agreeable odor; lamellae adnexed, very broad, usually deeply emarginate, subdistant, white; spores subglobose or broadly ellipsoid, smooth, hyaline, 7–10 × 6–7 μ; stipe equal or tapering upward, often striate, whitish, sometimes slightly pulverulent at the apex, fleshy, stuffed or hollow, 7.5–12 cm. long, 2 cm. thick.

This large, conspicuous species is abundant throughout most of temperate North America and Europe, occurring in thin woods on and about deciduous logs and stumps, from June to October. The collector is apt to assign it to the genus *Melanoleuca*, because of its sinuate lamellae and rather fleshy stipe, but it may be distinguished from most of the species of this genus by its wood-loving habit. Although edible, it is quickly attacked by insects and also decays rapidly, so that it is practically of very little economic importance.

Lepiota amianthina (Scop.) Quél.

GRANULOSE LEPIOTA

Plate 158. Figure 5. × 1

Pileus ovoid to campanulate and expanded, subumbonate, 2–6 cm. broad; surface finely to coarsely granulose, ochraceous to reddish-ferruginous varying to pallid or pinkish; context thin, white or yellowish, often with a disagreeable odor; lamellae free

to adnexed or adnate, rather broad, close, white becoming yellowish; spores ellipsoid or subglobose, smooth, hyaline, 3–7 × 2.5–4 μ; stipe subequal, slender, fistulose, scaly below the annulus and concolorous, 4–8 cm. long, 2–7 mm. thick; veil lacerate, more or less appendiculate.

This species is common in a great variety of forms throughout temperate North America and Europe, occurring in woods on the ground or at times on decayed logs. The surface of the pileus is characteristically granulose, although its variations in color are very confusing, and the lamellae may be free, adnexed, or adnate. A monograph of the 88 North American species of the genus *Lepiota* appeared in Volume 10, part 1, of *North American Flora,* issued in July, 1914.

Lentodium squamosum (Schaeff.) Murrill

SCALY LENTODIUM

Plate 158. Figure 6. × 1

Pileus fleshy to tough, compact, hard when dry, convex or nearly plane, sometimes slightly depressed in the center and sometimes umbonate, solitary or cespitose, 5–15 cm. broad; surface white or pale-ochraceous, the cuticle cracking and usually forming brownish, spot-like scales, which are sometimes almost black; context white, with agreeable odor; lamellae subdistant, broad, sinuate-decurrent, transversely lacerate and dentate-serrate on the edges, white; spores ellipsoid, 7–15 × 3–6 μ; stipe white or whitish, short, hard, solid, often pointed at the base, more or less adorned with recurved scales, sometimes eccentric, 2.5–6 cm. long, 6–12 mm. thick; annulus fixed, white, often disappearing.

This conspicuous species, usually known as *Lentinus lepideus,* occurs abundantly throughout temperate and tropical North America, as well as in Europe and Asia, on structural timbers and logs, especially of coniferous trees. It is very important as a timber-destroying fungus, railway ties being particularly subject to its attack. Although not poisonous, it is too tough to be used for food. Its large size and scaly surface should enable the student to distinguish it very readily.

Hypholoma Candolleanum (Fries) Quél.

VIOLET-GILLED HYPHOLOMA

Plate 158. Figure 7. × 1

Pileus thin and fragile, convex to expanded, gregarious or cespitose, 3–6 cm. broad; surface smooth or rugose, striate at times, glabrous or slightly floccose, hygrophanous, dark-fulvous, fading to isabelline on dry days; lamellae adnexed, crowded, narrow, pallid to purplish when young, purplish-black with age; spores oblong-ellipsoid, very blunt at each end, smooth, dark-brown in mass, pale-purplish-brown under the microscope, copious, 6–7 × 3–4 μ; stipe slender, equal, hollow, white, smooth, glabrous or slightly flocculose, striate at the apex, 3–7 cm. long, 4–6 mm. thick; veil white, very slight and delicate, clinging partly to the margin and partly to the stipe, soon vanishing.

This edible species is not uncommon on the ground or on rotten wood in deciduous woods in temperate regions, although it is not well known in this country. DeCandolle originally assigned to it the name *Agaricus violaceolamellatus,* on account of the violet color of the young lamellae, by which it may be distinguished from its very near relative, *Hypholoma appendiculatum,* described and figured in *Mycologia* for January, 1912. Fries, in 1818, changed the name to *Agaricus Candolleanus,* probably disliking the specific name chosen by DeCandolle because of its length. The specimens I have seen do not show the violet color in the very young lamellae and are not so large as the European plant, but, in a difficult group like this one, I suppose some allowances must be made.

NEW YORK BOTANICAL GARDEN.

NOTES ON CRYPTOPORUS VOLVATUS

SANFORD M. ZELLER

(WITH PLATE 159 AND 1 TEXT FIGURE)

Crytoporus volvatus is unique among polypores, for the pore-bearing layer is hidden by a volva. It is thus often termed the "hidden-pore fungus" or the "volvate polypore." During the fall of 1911, the writer frequently found this species on fallen coniferous trunks. Since that time, many specimens of it have been collected. They were growing from such hosts as Douglas fir (*Pseudotsuga taxifolia*), the western hemlock (*Tsuga heterophylla*), and white fir (*Abies grandis*). During the months of March and April, 1912, I had the opportunity of observing quite thoroughly the development of the sporophores of this fungus, and a few words might be said here to supplement what Peck (3) has already said concerning some advanced stages of the pileus. Two trees of *Tsuga heterophylla* found on the campus at the University of Washington were thoroughly infected. This gave splendid opportunity to observe the sporophores in different stages.

The very young stages of the sporophores of *Cryptoporus* are globose and covered with a thick crust of reddish-brown resin exuded from the tree. As the button grows, this crust becomes thinner and thus the sporophore appears to grow lighter in color. Because of this coating of resin, no satisfactory method of killing and embedding for histological work was found. However, some free-hand sections were made and examined after staining with eosin. In the earlier stages the button is an undifferentiated mass of fungous filaments. The cortex is soft-fleshy, hygrophanous, and white. Soon a tiny spherical cavity appears in the center of the button, when the latter is from 3 to 4 mm. in diameter. This increases in size with the growth of the button and the fleshy tissue increases in thickness up to about 3 mm. Until the sporophore is about 12–20 mm. in diameter, the tissue is about the same

thickness above and below the cavity, but at this stage when the hymenium begins to form in the ceiling of the cavity, as it were, the portion above becomes thicker while the portion below (the volva) becomes thinner. Peck (3) says this portion above the pore-bearing layer is in two strata, an outer thicker one and an inner thin stratum. Just when these strata of the fundamental tissue are differentiated is not known. In these later stages an appendage appears inside of the volva and protruding from around the hymenophore. This has been figured by Peck (3) and is imperfectly shown in some of the sections in the accompanying plate. It is probable that this appendage is not a constant characteristic. In some specimens it does not extend wholly around the hymenophore but forms irregular, tuberculose projections. In other specimens it appears as a very low ridge encircling the pore-bearing layer. As the volva becomes thinner, it grows downward in the portion near the attachment of the sporophore. Here it becomes very thin and the ostiole of the volva is formed. This is always very close to the tree trunk.

Until nearly the time when the ostiole is formed, the whole sporophore is very fleshy and watery. Now it begins to shrink somewhat by the loss of water and the texture becomes soft-corky and still of a white color. The tubes become yellowish to almost cinnamon. The shrinking of the whole sporophore causes a cracking of the resinous crust, which often scales off. In the old sporophores this leaves the white surface glabrous, but often anastomosingly rimose. The development of the sporophore as observed from free-hand sections is illustrated by the series of median vertical sections on plate 159, while the mature sporophores with well-developed ostioles are shown on the same plate.

More detailed work on the development of this peculiar polypore should be done to determine the histological development and formation of (*a*) the primordium of the pore-cavity, (*b*) the primordium of the hymenium, (*c*) the thin interior stratum of the sporophore, of which the appendage mentioned above is the projecting edge, (*d*) the constancy of this projecting appendage, and (*e*) the ostiole of the volva.

Pure cultures of the fungus were made from the tissue of the young sporophores. Potato hard agar was used as a medium.

The mycelium grows abundantly in cultures, and in a period of four weeks conidiospores were formed. These varied from ellipsoid to pyriform in shape. They appear on short conidiophores from the clamp-connections which are abundant in the hyphae.

The first stages of sporophores were obtained in cultures. Small sticks of hemlock wood about one inch in diameter were cut so that they would stand erect in an Erlenmeyer flask. The borings of insects (to which reference is made later) were imitated by boring a small gimlet hole lengthwise following the pith

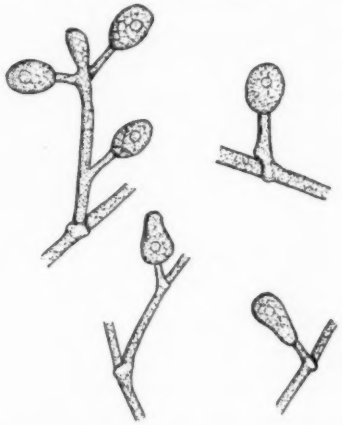

FIG. 1. Conidiospores formed in cultures of *Cryptoporus volvatus*.

of the stick. At right angles to this, other gimlet holes were bored, some near each end of the sticks. These sticks were put in flasks containing some agar and in such a way that some of the radial gimlet holes were just above the surface of the agar. After sterilization the agar was inoculated with *Cryptoporus* and the mycelium spread to the stick, entered the gimlet holes below, and emerged in the form of buttons above. These buttons grew in some cases to be 5–10 mm. in diameter but did not develop the internal cavity. The buttons formed in cultures were pure-white and without the ordinary coat of resin. The surface was perfectly even, dry, and glabrous.

The intimate relationship which exists between the attack of

timber by insects on the one hand and fungi on the other have been pointed out by several mycologists and entomologists. There are without doubt many fungi which follow the borings of insects. *Cryptoporus volvatus* is an example of this kind. It is found that a great many species of insects inhabit the pore-cavity. Hubbard (2) has dealt with the relation of insects to this fungus. The insects which wander in and out through the ostiole of the volva aid in the dissemination of the *Cryptoporus* spores. When the hymenium of the fungus begins to discharge spores the inside of the volva soon becomes covered with a heavy layer of spores and when the insects crawl in and out they take with them myriads of spores upon their bodies and appendages. Besides the large number of insects mentioned by Hubbard, the small fungus borer, *Sitodrepa panicea,* is found in nearly all of the mature sporophores and its borings in the tree extend quite a distance into the sapwood, where the insect would distribute the spores of the fungus.

This relationship of fungi and insects is surely significant in the dissemination of the spores of this fungus which has its fruiting surface so protected from other spore carriers, such as air currents, etc. However, it would be difficult to imagine that *Cryptoporus* is as dependent upon boring insects as suggested by House (1). He says that the volva aperture is the result of a boring weevil. This, however, is not consistent with the general appearance and development of the ostiole. During the stage of development when that portion of the volva had become thin and wholly vanished, with the exception of bits of the dead fundamental tissue, the writer has often cracked off the crust of resin from the under surface of the volva and thus disclosed a perfectly formed ostiole, through which no insect had ever passed. The margin of the ostiole is round and has the characteristic surface of the other portions of the fungus and very unlike the edge of a beetle boring. The ostiole of the volva of *Cryptoporus volvatus* is a morphological characteristic.

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FIG. 1. SPOROPHORES OF CRYPTOPORUS VOLVATUS SHOWING OSTIOLE

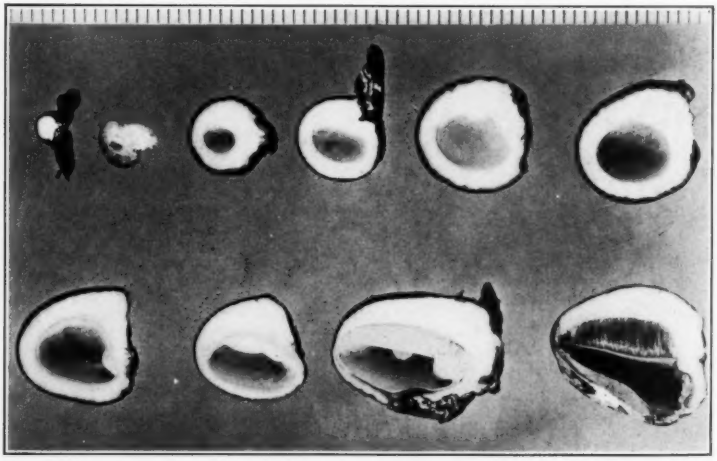

FIG. 2. SPOROPHORES OF CRYPTOPORUS VOLVATUS SECTIONED TO SHOW PORE-CAVITY

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1. **House, H. D.** Origin of the volva aperture in *Cryptoporus volvatus* (Peck) Shear. Mycologia **6**: 217–218. 1914.
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DESCRIPTION OF PLATE CLIX

FIG. 1. Sporophores of *Cryptoporus volvatus* (Peck) Shear. The two smallest ones show the resinous coating completely covering the surface. The ostiole of the volva has not appeared in this stage. Others show the resinous coat partially cracked from the surface exposing the white fungal tissue. Dead fundamental tissue is left adhering to the margin of the ostioles.

FIG. 2. Stages in the development of the sporophores, showing the enlargement of the pore-cavity, the gradual formation of the hymenophore and the ostioles of the volva.

THE EFFECT OF CONTINUED DESICCATION ON THE EXPULSION OF ASCOSPORES OF ENDOTHIA PARASITICA

F. D. Heald and R. A. Studhalter

The importance of ascospore expulsion in the dissemination of the chestnut blight fungus has been emphasized by various writers since the process was first observed by Rankin. A brief consideration of the work bearing on this phenomenon is presented in the historical introduction to a recent article[1] and will not be repeated here.

The effect of continued desiccation on the expulsion of ascospores has an important bearing on dissemination, since chestnut products bearing perithecial stromata are frequently transported for some distance. If these products are dried, the question has been raised as to how long the perithecia will retain their power to eject spores if subjected again to favorable conditions of moisture and temperature.

Anderson and Babcock[2] first brought out the fact by laboratory tests that expulsion of spores is resumed after desiccation if moisture is supplied. The longest period of drying recorded in this first work was seven days and this appeared to have little or no effect on the power of the perithecia to expel spores. In a later article by Anderson and Rankin[3], the influence of long desiccation is reported as follows: "The writers also found that the perithecia will retain their ability to eject spores for at least seven

[1] Heald, F. D. & Walton, R. C. The expulsion of ascospores from the perithecia of the chestnut blight fungus, *Endothia parasitica* (Murr.) Anders. Am. Jour. Bot. 1: 499–521. *f. 1, 2.* 1914.

[2] Anderson, P. J. & Babcock, D. C. Field studies on the dissemination and growth of the chestnut blight fungus. Bull. Pa. Chest. Tree Blight Comm. 3: 1–45. 1913.

[3] Anderson, P. J. & Rankin, H. W. The Endothia canker of the chestnut. Bull. Cornell Agr. Exp. Sta. **347**: 531–618. 1914.

months under perfectly dry conditions." No detailed description is given of the tests on which this statement is based.

Alternate drying and drenching of cankers is, of course, the normal condition in the field. Work to be reported later has brought out the fact that under these conditions given areas of the bark of cankers will continue to expel ascospores through all or at least parts of two seasons.

METHOD

Bark showing an abundance of mature perithecial stromata was collected at Emilie, Pa., on July 15, 1913. The bark was then moistened and tested to make sure that the perithecia were in a condition to expel spores.[4] As soon as any specimens showed expulsion of spores, they were allowed to dry. By July 21, 1913, all the specimens to be retained had been tested and were thoroughly dry. They were then grouped in packets of six specimens each, giving to each lot as near as possible uniform material. They were then stored in a closed pasteboard box and retained in the laboratory.

Each of the six pieces of bark in a packet was of sufficient size to support an object glass. Tests were made at about monthly intervals employing six pieces each time. The method employed was that previously described by Heald and Walton.[5]

RESULTS

The results obtained by the different tests can best be presented in tabular form (Table I). From this summary it may be noted that the perithecia still retained the power to expel spores after 11 months and 18 days of continuous drying. In all probability the limit was not reached, as the perithecia seemed to develop as strong powers of spore expulsion during the last test as in any of the earlier ones. In the majority of cases all of the pieces of bark tested showed active ostioles after being subjected to favorable conditions for a sufficient length of time, and there was

[4] The material was collected by Mr. R. C. Walton and some of the earlier tests were made by him.

[5] Loc. cit.

TABLE I

SUMMARY OF EFFECT OF DESICCATION ON ASCOSPORE EXPULSION

Period of Desiccation	No. of Pieces Showing Expulsion	Day of Test on Which 1st Expulsion Occurred	Day of Test on Which the the Last Trap Began to Show Active Ostioles	Maximum No. of Active Ostioles per Day on Any Trap	Duration of Test
1 mo., 13 days	5	2	11	100+	1 mo., 12 days
2 " 3 "	6	2	26	72	1 " 15 "
3 " 3 "	6	19	24	200+	1 " 3 "
4 " 7 "	5	21	58	200	2 " 18 "
5 " 9 "	6	23	54	200+	2 " 2 "
6 " 13 "	5	30	39	200	1 " 28 "
8 " 3 "	5	38	48	40	2 " 3 "
8 " 17 "	6	30	38	300+	1 " 20 "
9 " 14 "	6	20	29	250+	1 " 6 "
10 " 14 "	6	17	22	200+	1 "
11 " 18 "	6	18	21	250+	1 "

never more than one in any set in which no active ostioles were present. After one and two months of drying, certain perithecia began to expel spores on the second day of the test, but with longer desiccation the initiation of the process was considerably delayed, the number of days required varying from 17 to a maximum of 38. Even during the early part of the desiccation period

TABLE II

RECORD OF TYPICAL SPECIMENS SHOWING CHARACTERISTIC INCREASE IN THE ACTIVITY OF SPORE EXPULSION

No. of Day	Nos. of Specimens and the Number of Active Ostioles on Successive Days							
	339	345	347	373	384	387	393	394
1	4	3	3	7	2	10	15	12
2	5	4	2	24	20	30	18	30
3	11	9	6	50	30	90	42	52
4	13	32	16	85	60	250	80	78
5	28	35	23	80	65	250+	100	80
6	41	154	31	175	75	"	130	60
7	60	158	46	300	100	"	150	65
8	69	178	47	300+	100+	"	100	15
9	89	150	54	"	"	"	"	15
10	112	193	58	"	"	"	"	14
11	97	200+	63	"	150	"		17
12	68	200+	67	"	150+	"		13
13	119	"	61	"	"	"		
14	172	"	73	"		"		
15	126	"	76	"		"		

the beginning of spore expulsion was considerably delayed in some of the specimens. The day of the test on which the last

specimen showing expulsion began its activity varied from 11 to 58 days.

Many of the specimens showed a marked and characteristic increase in the number of active ostioles after the beginning of spore expulsion. There appears to be a gradual increase to a maximum of activity with more or less fluctuation after the maximum has been reached. This peculiarity is illustrated by the record for a number of typical specimens as presented in the accompanying table (Table II). In the majority of cases the record was not continued beyond the maximum of activity.

THE VIABILITY OF THE SPORES EXPELLED FROM DESICCATED PERITHECIA

The longevity of ascospores of the chestnut blight fungus has been reported from tests made on material stored under different conditions. According to Anderson,[6] ascospores ejected from perithecia on to glass slides continued viable for five months and six days, while Anderson and Rankin[7] report that spores taken directly from perithecia in desiccated bark retained the power to germinate for a much longer period. Their statements on this point are as follows: "At the end of one year very little diminution in the percentage of germination could be seen." "In another series of experiments a large percentage of ascospores similarly stored germinated after eighteen months." No germination tests were reported of spores expelled from desiccated perithecia, but judging from their results on spores taken direct from dried material, one would expect a good germination of spores expelled after a prolonged drying of the bark.

During the progress of the work on spore expulsion reported in this paper, germination tests of the expelled spores were made. In each determination the percentage of viable spores was determined in duplicate cultures by the hanging-drop method. A spore print from a given specimen was covered with sterile water and rubbed up with a sterile loop to secure a uniform suspension, and the culture made by transferring spores from this suspension

[6] Anderson, P. J. The morphology and life history of the chestnut blight fungus. Bull. Pa. Chestnut Tree Blight Comm. 7: 1–44. 1913.

[7] Loc. cit.

to dextrose agar. The results of these germination tests are shown in Table III. The slight reduction in germination per-

TABLE III

GERMINATION PERCENTAGES OF ASCOSPORES EXPELLED FROM DESICCATED BARK

Specimen Number	Period of Desiccation	Germination Percentages	Average Germination Percentages
341	5 mo., 9 days	98	98.25
341	" "	98.5	
345	5 mo., 9 days	86.75	86.27
345	" "	85.8	
349	6 mo., 13 days	59	61
349	" "	63	
350	6 mo., 13 days	81.5	82.25
350	" "	84	
373	8 mo., 17 days	69.7	69.3
373	" "	68.9	
392	10 mo., 14 days	50	36.58
392	" "	29.16	
393	10 mo., 14 days	78	77.9
393	" "	77.8	

centage is in agreement with the results reported by Anderson and Rankin for ascospores under the conditions of their tests.

CONCLUSIONS

Continued desiccation does not inhibit the power of the perithecia of *Endothia parasitica* to expel spores when subjected to favorable conditions of temperature and moisture. It does, however, lengthen the period from the beginning of favorable conditions to the first expulsion. On account of this fact, it does not seem probable that perithecial material which has been retained in a dry condition for three months or more would ever be subjected under natural conditions to favorable influences for a sufficient length of time to induce spore expulsion. Material dried for one or two months, might, however, be a source of danger, as more or less expulsion might be induced by natural agencies.

Spores expelled from desiccated perithecia show little or no reduction in the percentage of germination.

It seems probable from our results and from those of others already cited that the time limit of ability to expel ascospores was not reached in the tests here recorded.

LUMINESCENCE IN THE FUNGI

WILLIAM A. MURRILL

The phenomenon of phosphorescence, or luminescence, in living organisms has long been known and wondered at, but there remains much to be learned about the entire subject. The light-bearing fishes of the deep sea, the "sparkling" waves at the sides of a ship on a dark night, the firefly and glowworm, and luminous bacteria occurring on decaying fish, cabbage, etc., are well known. Molisch's bacteria lamp designed for mines and powder magazines was an attempt to put this process of slow oxidation to some practical use.

In animals, the light is usually brief and intermittent, while certain fungi may give off light continuously for days, weeks, or even months, so long as the light-giving cells are uninjured and active and water is present. This light-giving power is recognized as useful to animals, but is probably without biological significance in plants. One can hardly believe that the spores of *Clitocybe illudens*, for example, are distributed to any great extent by the moths and fireflies that happen to be attracted by the weird light emanating from its spore-bearing surface.

In some fungi, the power of luminescence is confined to the active cells of the mycelium. This is true in the case of *Armillaria mellea*, which inhabits old stumps and often causes them to glow on dark nights. While the rhizomorphs of this species are covered with active hyphae, they are luminous, but when they form a cuticle and enter the resting period the luminosity disappears. The mycelium of the hymenophore of this species is not luminous even when most active.

On the other hand, the sclerotia of *Collybia tuberosa* are said to be luminous; and the writer has observed that the mature hymenophores of *Panus stypticus* may be luminous when the young ones are not. *Xylaria Hypoxylon* is reported luminescent when growing naturally but not in pure cultures, which may pos-

sibly be due to the association of photogenic bacteria or other light-producing organisms.

It is impossible to give an accurate and complete list of the more conspicuous luminescent fungi, and some of the names recorded in the literature are very probably synonyms. Among North American species, the following have been reported to have the power to produce light, either in the mycelium or in some part of the fruit-body.

Armillaria mellea (Vahl) Quél.
Ceriomyces crassus Batt.
Clitocybe illudens (Schw.) Sacc.
Collybia longipes (Bull.) Quél.
Collybia tuberosa (Bull.) Quél.
Corticium coeruleum (Schrad.) Fries
Fomes annosus (Fries) Cooke
Laetiporus speciosus (Batt.) Murrill
Panus stypticus (Bull.) Fries
Polyporus caudicinus (Scop.) Murrill
Porodaedalea Pini (Thore) Murrill
Xylaria Hypoxylon Pers.

To the above preliminary and very incomplete notes, may be added a few simple observations made on *Clitocybe illudens*, the most conspicuous of our luminescent species. The writer has frequently collected the beautiful orange hymenophores in New York, Virginia, North Carolina, and other states, and almost invariably they have been found to be luminous. On August 21, 1911, at 8 a. m., I collected about two bushels of the hymenophores of this species from an old oak stump in a low, shady woodland east of Bronx Park and brought them to my office in a large basket covered with fresh ferns. Several specimens, including wood containing the mycelium, were taken into the dark room at 8:30 a. m., but they exhibited no luminosity. At 10 a. m., a large cluster was first tried in the dark room, then exposed to diffused sunlight for an hour, and afterwards heated to 90° C. in 7 minutes in a drying oven, and at no time did it become luminous.

At 11 a. m., a cluster was immersed in cool water and left there 20 minutes, but this did not make it luminous. The water, now colored pale-orange, was tested in the dark room, but showed no luminosity. It was not to be expected that either the dissolved

coloring matter or the mature spores held in suspension would possess photogenic properties.

At 1:30 p. m., the entire collection of hymenophores was taken from the herbarium to the dark room without removing them from the original basket, and no trace of light was observed during a period of 7 minutes. A piece of wood was then discovered in which the mycelium was evidently fresh and active, and this showed beautiful luminescence in a few seconds. On breaking this wood into pieces, the interior was even more luminous. Hymenophores were then broken apart and the mycelial cords at the base of the stipe exposed, with only negative results.

At 7:30 p. m., specimens taken from the herbarium to my home were tested in a dark closet in the presence of five people and in 1½ minutes the under surfaces of all the hymenophores were seen to glow conspicuously, while the upper surfaces remained dark. Water had no effect; dissolving out the coloring matter had no effect; and the colored liquid obtained was not luminous.

On August 22, at 8 a. m., I tried hymenophores of the same collection in the dark room at the Garden for 8½ minutes with entirely negative results, while wood containing the active mycelium was seen to glow distinctly within a minute or less. At 9 a. m., the specimens taken home the previous afternoon were examined in a dark closet and appeared luminous after 10 to 15 minutes. Pieces of wood containing the mycelium were found to glow promptly after lying in the herbarium all day.

At 9 p. m., the hymenophores at my home were again tested and luminosity was observed in 1 or 2 minutes. These specimens had been examined at 9 a. m. on the same day and during the evening of the previous day, lying meanwhile on a table in the living room.

On August 23, at 9:30 a. m., the wood containing mycelium, which had been lying on my desk in the herbarium, was found to be dry and no longer capable of luminescence. The observations were then discontinued.

NEW YORK BOTANICAL GARDEN.

THE PENICILLIUM LUTEUM-PURPUROGENUM GROUP[1]

CHARLES THOM

Wehmer[2] in a recent paper pointed out what he believes to be natural cleavage lines among the species commonly lumped together under the generic name of *Penicillium*. In that paper he reasserts the validity of his separation of *Citromyces* as a separate genus, transfers the coremiform species *P. claviforme* and *P. silvaticum* to the genus *Coremium* Link, incorrectly attributed to Corda, and revived for the purpose, and indicates the desirability of separating *P. brevicaule* and its allies without recognizing that this was done by Bainier[3] in 1907 under the name of *Scopulariopsis*.

The validity of the latter group has been amply confirmed by the work of Miss Dale,[4] whose cultures have been seen by the writer of this paper.

The application of the name *Coremium* to *P. claviforme* Bainier and *C. silvaticum* Wehmer is appropriate. Whether the botanical rules of nomenclature will permit such use is, however, very doubtful from the history of the name *Coremium* as given elsewhere.[5]

If the *Coremium* group were limited to the two species named, separation would be easy. However, *P. duclauxi* Delacroix

[1] Published by permission of the Secretary of Agriculture. This paper is a revision and extension of a paper read before the Botanical Society of America in Philadelphia, in December, 1914, under the title "The Penicillium Group Verticillatae of Wehmer."

[2] Wehmer, C. Ber. deut. Botan. Ges. **32** (1914), Heft. 5, pp. 373–384. *Coremium silvaticum* n. sp. nebst. Bemerkungen zur Systematik der Gattung *Penicillium*.

[3] Brainier, G. Bul. Soc. Myc. France, **23** (1907), p. 98.

[4] Dale, E. On the fungi of the soil. Ann. Mycol. **12** (1914), No. 1, pp. 33–62.

[5] Thom, C. Cultural Studies of Species of *Penicillium*, U. S. Dept. Agr. Bur. Anim. Ind. Bul. 118, Washington, 1910.

under some conditions of culture falls definitely within the *Coremium* group as used by Wehmer. Under other conditions it becomes a simple *Penicillium*.[6] *P. expansum* Link, observed upon a rotten apple, is usually typical for the genus *Coremium*, but when transferred to culture media becomes a *Penicillium* again, which under many cultural conditions shows no sign of coremia.

Sopp[7] has also definitely broken the penicillately fruiting organisms into several genera upon morphological lines.

The difficulties encountered in the use of either plan suggest the desirability of continuing the general use of the name *Penicillium* for the entire group until definite natural lines of cleavage can be established.

Penicillium, in the narrowest sense, as discussed by Wehmer, includes those forms which produce green mold surfaces consisting of a large number of separate conidiophores. Within this narrowest group he finds also natural cleavage lines which perhaps represent real relationship. He has pointed out one such natural group and suggested that it be called the Verticillatae. This section and a single series within this group form the subject of this paper. In the past ten years about fifteen members of this series have been collected from widely separated regions. Some of them, *P. luteum*, *P. africanum*, *P. pinophilum*, and *P. purpurogenum* were already named and described without indication of relationship. Several, for example, *P. africanum* and *P. purpurogenum*, among named forms, are closely enough related to make separation troublesome even to the describer.[8] When several other members of the series are added, the description of each in terms which will insure identification by the next worker becomes more difficult, perhaps impossible. Descriptions and figures for a series of these forms were prepared, laid away, then reread, and compared along with fresh cultures and accumulated cultural data. Some of these forms have been kept in continuous culture for about ten years. They maintain the individuality of old friends. Such strains are well established biological entities but to draw a tech-

[6] Thom, C. l. c.

[7] Sopp, O. Johan-Olsen. Monographie der Pilzgruppe, *Penicillium*, etc. Videnskapsselskapets Skrifter I. Mat.-Naturv Klasse 1912, No. 11, Christiana, 1912.

[8] Doebelt, H. Ann. Mycol. 7 (1909), No. 4, pp. 315–338.

nical characterization which will surely separate them is exceedingly difficult. The common morphological characters have, therefore, been brought together to define the section Verticillatae of the whole group of penicillate organisms in the sense of Wehmer. These characters follow:

MORPHOLOGICAL CHARACTERS OF SECTION VERTICILLATAE

Conidiophores vary greatly in length. Each conidiophore typically produces a crown or verticel of metulae,[9] or fertile branches. From this arrangement Wehmer derives the name Verticillatae. The metulae are few to many in the verticel; the number differs in the different members of the series. They are usually closely clustered. Careful search in nearly every strain shows an occasional conidial fructification in which a secondary verticel is borne either upon the main conidiophore prolonged through the center of the primary verticel or upon some one of the metulae of the primary series. Both conditions are found, but only in small numbers under the usual conditions of culture.

This section includes many species, some of which form series in which further relationship is suggested. Others diverge widely. One such series of forms has been collected and may be designated the luteum-purpurogenum series from the well known forms which stand at the extremes.

THE LUTEUM-PURPUROGENUM SERIES

At one end of this series stands a strain of *P. luteum*[10] Zukal which produces ascospores freely in all the media used and conidia very sparingly. In the actively growing culture the dominant shades of color are yellow with tardy appearance of red. At the other end stands *P. purpurogenum* Stoll,[11] which produces only conidia, in which yellow shows transiently, while red colors in mycelium and substratum are abundant.

[9] Westling, R. Arkiv. för Botanik. Bd. 11, No. 1, p. 44, in Ueber die grünen spezies der Gattung *Penicillium*.

[10] Described as *P. luteum* in Bul. 118, B. A. I. U. S. Dept. Agr. The culture was cultivated by Prof. R. Thaxter in 1905.

[11] Stoll, O. Beiträge zur Morphologischen and biologischen Characteristik von *Penicillium*, Inang. Dissert. Stuttgart 1903–4.

Among these forms is one well-marked organism (No. 2670) *P. purpurogenum* var. *rubri-sclerotium*, with all the common characters of the series but producing abundant sclerotia, dark-red to black in color, upon the surface of the substrata. If these sclerotia should be found to be undeveloped perithecia, the form would be clearly eliminated from genetic relationship to the forms at the luteum end of the series, but would probably take with it the other forms at the purpurogenum end of the series.

COLONY CHARACTERS

The production of yellow in the surface growth at some period of colony development or under some cultural conditions is typical for the group. This may be dominant, transient, or almost lacking yet it is not difficult to demonstrate in the organisms studied. Microscopic examination shows this color to be due to the encrustment of the aerial hyphae, or part of them, with yellow granules. Definite quantitative differences in this color are shown by successive cultures of the same strain in different media, especially in media with differing reaction. The different numbers of the series show fairly constant differences in the amount of yellow color produced. This quantitative difference is partly at least due to the characteristic differences in the amounts of surface mycelium produced by the different races. Color increases with floccosity. In *P. pinophilum*, Hedgcock[12] found that the color of the granule was yellow when acid, and a reddish shade when alkaline. In the strain of *P. luteum*, previously described (Bul. 118, Bur. Anim. Ind. U. S. Dept. Agr., No. 11), the yellow is a dominant factor during the early growth of the organism, giving place but partially to reddish hyphae in age. The whole culture gets its color from the yellow granules.

The descriptions of Wehmer[13] indicate the production of conidia much more abundantly by his strain of this species. The subsequent discovery of ascospores conforming to the descriptions of *P. luteum* in other American strains suggested the relationship of this whole series. The ascus-producing forms when brought together show a progressive loss in ascus producing

[12] Hedgcock, G. G. Missouri Bot. Garden, Rept. 17, pp. 105–107.

[13] Wehmer, C. Ber. deut. Botan. Gesellsc. 1893, p. 499.

power with progressive development of large conidial areas until we reach forms with few ascigerous masses. From these to the forms with no asci is the next natural step. This transition is suggested by the general morphology of certain forms on which asci have been produced in culture. In every member of the series careful observations show at least a narrow fringe of hyphae studded with yellow granules, about the margin of the developing colony. The yellow is quickly covered by the mass of green spores but usually may still be seen with the microscope.

COLOR IN THE SUBSTRATUM

Coincident with the change of color in the surface or aerial growth we find at the luteum end of the series that yellow to orange shades predominate in the substratum. These slowly or but partially change to red as the colonies become old. In the forms producing conidia only, yellow or orange tones still appear in the young colony. The change to red is slow and only partial in some forms but towards the purpurogenum end of the series the yellow colors are reduced to but transient appearances, replaced quickly and almost completely by red. Observations upon these changes must be repeated at intervals during a period of two to three weeks.

MORPHOLOGY

The members of this series show the conidiophore character of the whole section. Together with color production, however, they display an essential uniformity in sterigmatal and conidial characters, shared with some but not all the forms showing the conidiophore and branching described by Wehmer for the Verticillatae.

STERIGMATA

Each branch or metula bears at its apex a closely packed cluster of sterigmata[14] (syn. basidia, conidiiferous cells) or conidium-bearing cells. These are closely packed and continue as nearly parallel as mechanical conditions permit. They widen gradually

[14] The use of the term sterigmata here follows Westling who has discussed this series of terms fully, l. c., p. 47.

from the base upward for 5 to 8 μ, then taper slowly to the diameter of the conidium producing tube,[15] with a total length of from 10 to 15 μ. The length of these cells, their lanceolate or lance-acuminate form and closely parallel arrangement is characteristic for the whole group.

CONIDIA

The conidia arise as cylindrical cells which change usually through fusiform to elliptical or in some cases almost globose, with walls, when fully ripe, either smooth or delicately roughened, or sometimes both in the same culture. The fusiform to elliptical shapes are most common. Variation in size in the same strain and usually in the same culture is very marked. Even strains with conidia averaging small have some which reach the sizes shown by the larger spored forms. Very large single spores and chains of spores are abundant in some strains while rare, or perhaps absent in others. In forms where the conidia have been germinated under observation the conidia swell to these large sizes while germinating. Masses of conidia where present give some shade of green to that part of the colony.

It is, therefore, possible to bring this group together in such a way as to aid the worker in locating the strains found. Whether any one can so define the appearances of each of the separate strains as to ensure identification by others is doubtful. Perhaps for most purposes it is immaterial.

A synoptical arrangement of the strains considered in this paper has been prepared from cultures grown in Czapek's solution agar.[16] When incubated at 37° C. five strains failed to grow, namely, Nos. 2647, 3525.15, 3523.4y, 2751, and 4010.9. The other strains grew well at blood heat. The cultures which failed

[15] Thom, C. Conidium production in *Penicillium*. Mycologia 6 (1914) No. 4, pp. 211–215.

[16]

Distilled water	1,000 c.c.
Magnesium sulphate	0.5 gram
Dipotassium phosphate (K_2HPO_4)	1.0 "
Potassium chloride	0.5 "
Ferrous sulphate	0.01 "
Cane sugar	30.00 grams
Agar	15.00 "

to develop at 37° C. grew freely as soon as the temperature was lowered. These five strains were distributed through the luteum section of the group; all of the purpurogenum section grew well at blood heat. The arrangement of the forms in the series presents their natural relationship as far as such relationship is determinable. The inclusion and placing of *P. duclauxi* is more or less arbitrary and perhaps due only to superficial evidence. The correlation of colors, color changes, and morphology suggest that the other strains may be safely grouped about *P. luteum, P. rugulosum, P. pinophilum,* and *P. purpurogenum* without offering specific names at present for new species.

SYNOPSIS OF THE SERIES

A.[17] Growing colonies with prominently yellow areas and reverse yellow to orange slowly replaced by reds—Luteum Section.

B. Ascigerous masses found.

a. Ascigerous masses abundant, conidial fruits few, scattered; colonies when young predominantly citron-yellow to strontium-yellow (Ridgway XVI), becoming partially and tardily pale-flesh-color or flesh-color (Ridgway XIV); submerged mycelium and agar (reverse of colony), shading from yellow toward orange-red or red. *P. luteum* Zukal.[18] Cultures No. 11 from[19] Prof. Thaxter, Cambridge, Massachusetts, No. 3522.3 by Dr. J. R. Johnston from Puerto Rico soil.

aa. Ascigerous masses few, green conidial areas well developed with conidiophores more or less in tufts. Yellow color predominates at edge and about ascigerous masses. Reverse colors from yellow toward orange and red. Culture, Thom, No. 2751, sent by Prof. M. T. Cook, from New Jersey.

BB. Ascigerous masses not found.

b. Colonies with sterile areas citron or strontium-yellow and conidial areas changing to flesh-color in age, shading with the amount of green conidia from sea-foam or chartreuse-yellow through citron, lime or chrysolite-green to densely conidial areas near ivy-green (Ridgway XXXI).

c. With conidial areas in scattered tufts; culture from rotting apple.[19] Thom, No. 3525.95, Washington, D. C.

cc. With large more or less irregular green areas. Cultures 3525.15 from rotting apples, Washington, D. C.; Thom No. 4010.9 from Seattle, Washington.

[17] Correlative divisions are indicated by duplication of index letters *A, AA; c, cc,* etc.

[18] *P. luteum* Zukal, Sitzber. K. Akad. Wiss. (Vienna) Math. Naturw. Kl. XCVIII, p. 521, 1889. Cultural description, Thom, C., U. S. Dept. Agr., Bur. Anim. Ind. Bul. 118, p. 39.

[19] Organisms from rotting apples were contributed by Mr. Brooks of the Bureau of Plant Industry.

ccc. With yellow area restricted to a narrow zone shading quickly to ivy-green. Culture Thom No. 3523.4y from Virginia soil.

bb. Colonies showing yellows above only in age, in reverse slowly but deeply orange to red. Conidia rough.

d. Without coremia—*P. rugulosum.*[20]

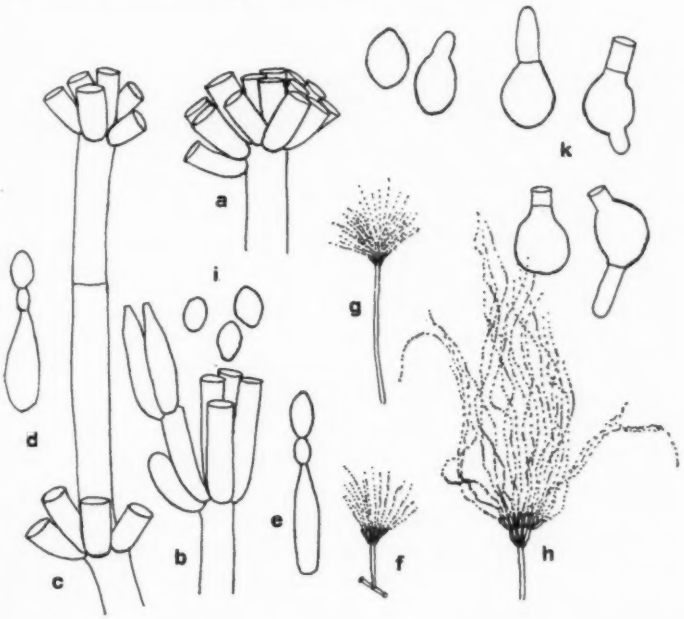

FIG. 1. *Penicillium purpurogenum* var. *rubri-sclerotinum*. *a, b,* typically verticillate branching at the apex of the conidiophore; *c,* in this conidial fructification the main axis is prolonged to bear a secondary verticel above the first; *e, d,* conidia bearing cells or sterigmata; *i,* conidia; *f, g, h,* diagrammatic representation of the entire conidial apparatus; *k,* germination of conidia. The morphology represented here shows the essential features of the entire group. In some the conidial chains are massed into solid columns, in others as in this divergent.

dd. With numerous long coremia—*P. duclauxi.*[20]

AA. Conidial areas prominent from the first. Reverse colors predominantly red. Pinophilum-purpurogenum section.

C. Colonies develop yellow and green areas together, which remain more or less persistently mixed.

[20] Thom, C., l. c. p. 60 and p. 42. The relationship of these organisms to each other and to the other members of the group may only be superficial but this necessitates their citation here.

e. Conidia rough; cultures 2647 and 2733 from English soil[21] and 2500 from New York soil.

ee. Conidia smooth, yellow hyphae becoming reddish in age, reverse and agar from salmon-orange to mahogany-red.

f. Floccose or tufted. *P. pinophilum* Hedgcock.[22] Numerous cultures obtained from soil and from food products can not be separated from this species.

ff. Velvety, broadly speaking. Thom No. 43.

CC. Growing colonies with margin variously changing through sea-foam green, chartreuse-yellow, or chrysolite-green (Ridgway XXXI), replaced by conidial areas toward celandine-green or andover-green (Ridgway XLVII). Reverse in reds toward oxblood-red (Ridgway I). Deep-red sclerotia developed in age. *P. purpurogenum*, var. *rubri-sclerotium*, var. nov.[23] This organism has been obtained from many sources and widely separated sections of the United States.

CCC. Colonies showing little or no yellow at first, yellow hyphae appear frequently in secondary growths in the centers or margins of older colonies. Reverse colors intensely red.

g. Conidiophores mostly borne as branches from interlacing aerial hyphae and ropes of hyphae.

h. Conidial fructification typically verticillate. *P. africanum* Doebelt, Ann. Mycol. 7 (1909) No. 4, pp. 315–338.

hh. Conidial fructifications branched several times. *P. funiculosum*, Thom, l. c., p. 70.

gg. Conidiophores arising as branches from separate hyphae. Complex ropes not found.

P. purpurogenum O. Stoll.[24]

Cultures have been found from American sources, especially several from corn (*Zea Mays*) which cannot be separated by satisfactory marks from the original strain distributed by Kral. The species is probably cosmopolitan.

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U. S. DEPT. OF AGRICULTURE.

[21] Contributed by Miss E. Dale, Cambridge, England.

[22] Thom, C., l. c. p. 31.

[23] *P. purpurogenum* var. *rubri-sclerotium*, var. nov. Differs from typical description of the species in the production of dark-red sclerotia on the surface of the substratum and in the well marked zone of yellow at the margin of the growing colony. It appears to be a soil fungus with well marked characters.

[24] The nomenclature of this form is discussed by Thom, l. c. p. 36.

STUDIES IN PORTO RICAN PARASITIC FUNGI—I

ESTHER YOUNG

The present paper is a report of the results of a study of the genus *Phyllosticta* as represented in Porto Rico, Desecheo, and Mona Islands. The material studied is from the collection of Dr. F. L. Stevens, and each specimen examined is reported under the original number. The specimens were all collected by Dr. Stevens in the years 1912 and 1913. The original collection was divided into two portions, one being left with the College of Agriculture and Mechanic Arts at Mayaguëz, Porto Rico, and the other donated to the University of Illinois. In my studies I have made use of the material in the collection of the University. The type specimen is in each instance indicated by its original number, and is deposited in the herbarium of the University of Illinois, and a duplicate cotype is also deposited with the New York Botanical Garden. In cases where the collection was reasonably large, the surplus cotype material is placed in the herbarium of the University. Occasional notes have been added by Dr. Stevens concerning local distribution, etc.

I hesitate somewhat to describe these new species as belonging to *Phyllosticta* rather than *Phoma,* since I believe there is no tenable distinction between these genera. However, since it is customary to regard the forms on leaves as belonging to *Phyllosticta,* probably no good would be done by breaking over that custom in this instance. The final designation of these and related forms must be made after a monographic study of the genus.

The writer is under obligations to Dr. F. L. Stevens, under whose direction the work was done, whose many kindnesses and suggestions have made this publication possible. Expressions of appreciation are also due to Dr. N. L. Britton, Mr. Percy Wilson, and Miss Margaret Slosson, of the New York Botanical Garden, and to Mrs. Agnes Chase, of the Bureau of Plant Industry, for assistance in determining host-plants.

1. **Phyllosticta adianticola** sp. nov.

Spots amphigenous, ovate to ovate-cuneiform, often acute at the basal ends, 4–12 mm. in diam., older portions ashen-gray, 1–2 × 2–4 mm., border yellowish-brown; pycnidia few, epiphyllous, brown, spherical, 72–120 μ in diam., ostiole distinct, dark-bordered, 12 μ in diam., conidia hyaline, ovate, slightly pointed at one end, 4.8–7.2 × 2.4 μ.

On leaves of *Adiantum tenerum* Sw. in Porto Rico: Manati, *4299* (type); Utuado, *4588;* Quebradillos, *5000.*

Apparently very common in all parts of the island of Porto Rico, though with very sparse pycnidia. This species is accompanied by a species of *Melanomma.*

2. PHYLLOSTICTA SACCHARI Speg. Rev. Facult. Agr. Veter. La Plata **1896**: 239. 1896

On *Saccharum* in Porto Rico. Juana Diaz, *102.*

3. **Phyllosticta Panici** sp. nov.

Spots indefinite, diffuse; pycnidia few, often in clusters, epiphyllous, dark-brown to black, spherical, 72–144 μ in diam., mycelium a brown mass of septate hyphae; conidia hyaline, ovate, 4.8–9.6 × 3.6 μ.

On leaves of *Panicum maximum* Jacq. in Porto Rico: Coamo, *830* (type); Martin Pena, *Heller 377.*

4. PHYLLOSTICTA COLOCASIAE Höhnel, Sitz.-ber. Akad. Wiss. Wien. **116**: 142. 1907

On *Dieffenbachia* in Porto Rico: Monte de Oro near Cayey, *5670.*

5. PHYLLOSTICTA COLOCASICOLA Höhnel, Sitz.-ber. Akad. Wiss. Wien **116**: 142. 1907

On *Colocasia* in Porto Rico: Caguas, *504.*

6. **Phyllosticta commelinicola** sp. nov.

Spots indefinite, diffuse; pycnidia subepidermal, numerous on the upper surface, light-brown, 96–168 μ in diam., ostiole distinct, dark-bordered, 24–48 μ in diam.; conidia hyaline, ovate, 9.6–14.4 × 4.8–7.2 μ.

On leaves of *Commelina nudiflora* L. in Porto Rico: Hormigueros, *214* (type).

7. PHYLLOSTICTA COCCOLOBA Ellis & Ev. Ann. Rep. Missouri Bot. Gard. 9: 118. 1898

On *Coccoloba* in Porto Rico: Mona Island, *6240*, *6168*.

In our specimens, the spots and spores differ somewhat from those of the description, the spots being larger and reddish-purple becoming gray in the center. The spores are shorter, measuring 2.4–4.8 × 2.4 μ.

8. **Phyllosticta momisiana** sp. nov.

Spots diffuse, sordid-white to yellow, margin indefinite, mostly affecting the apical and marginal portions of the leaf; pycnidia numerous, epiphyllous, dark-brown, spherical, 48–60 μ in diam., ostiole distinct; conidia hyaline, ovate, 4.8–7.2 × 2.4 μ.

On leaves of *Momisia iguanaea* (Jacq.) Rose and Standley in Porto Rico: Coamo, *834* (type).

9. **Phyllosticta Pithecolobii** sp. nov.

Spots amphigenous, subcircular to ovate, 5–10 mm. in diam., yellowish-brown to white in the center, margin slightly raised and darker, dark-brown below; pycnidia located mostly along the nerves, numerous on the upper surface, densely clustered, few below, spherical, regular, dark-brown, 120–240 μ in diam., ostiole distinct, dark-bordered, 24 μ in diam.; conidia hyaline, ovate, pointed at one end, 4.8–7.2 × 1.8–2.4 μ.

Very common wherever the host was seen.

On leaves of *Pithecolobium Unguis-cati* (L.) Benth. in Porto Rico: Desecheo, *1576* (type); Yauco, *3267*.

Phyllosticta Pithecolobii monensis var. nov.

Spots very much like those of the species but smaller, being 3–5 mm. in diam., margin darker and more regular; pycnidia smaller, 48–120 μ in diam.; conidia ovate, rounded at the ends, 4.8 × 2.4 μ.

On leaves of *Pithecolobium Unguis-cati* (L.) Benth. in Porto Rico: Mona Island *6137* (type).

It is perhaps significant that the host on Mona Island was of the thornless form. Though systematists do not recognize this as a distinct variety or species, the fungus upon it is distinctly different from that found on the excessively spiny Porto Rican form of host.

10. PHYLLOSTICTA DIVERGENS Sacc. Malpighia **5**: 281. 1891

On fruit of *Albizzia Lebbeck* (L.) Benth. in Porto Rico, *1875*.

This fungus is probably *Phyllosticta divergens* Sacc., which is reported on the leaves of this host, though there is no definite spot on the fruit as is described on the leaves. The conidia agree in length with those described but are narrower.

11. **Phyllosticta guanicensis** sp. nov.

Spots scattered, amphigenous, round, 1–2 mm. in diam., yellowish-brown with a reddish-brown slightly raised margin; pycnidia epiphyllous, few, scattered, spherical, 96–120 μ in diam., ostiole distinct, 12–15.8 μ in diam.; conidia hyaline, spherical to ovate, somewhat irregular, granular, 4.8–9.6 $\times$ 4.8 μ.

On leaves of *Guilandina crista* (L.) Small in Porto Rico: Guanica, *359* (type).

12. **Phyllosticta erythrinicola** sp. nov.

Spots few to numerous, scattered, small, circular, amphigenous, sordid-white, margin definite, regular, the brown centers falling out with age, portion of the leaf about the spot yellowish-brown; pycnidia epiphyllous, scattered, dark-brown, spherical 36–72 μ in diam., ostiole very dark, indistinct; conidia hyaline, ovate, minute, 2.4–3.6 $\times$ 1.2 μ.

On leaves of *Erythrina micropteryx* Poepp. in Porto Rico: Villa Alba, *110* (type); Jajome Alta, *5633;* Yauco, *3157;* Mayagüez, *68*.

Very common in all parts of the island, causing serious spotting of the foliage.

This species is distinct from *Phyllosticta Erythrinae*, which is reported on the branches of *Erythrina Lithospermae*. The pycnidia described are much larger, 90–180 $\times$ 60–70 μ, and lenticular in shape; the conidia were described as linear-ovate, 6–8 $\times$ 2 μ.

13. **Phyllosticta portoricensis** sp. nov.

Spots amphigenous, small, grayish becoming reddish-brown, circular to ovate, margin even, somewhat darker; pycnidia epiphyllous, few, scattered, dark-brown, spherical, regular, darker around the border, 60–90 μ in diam., ostiole distinct, 24–30 μ in diam.; conidia hyaline, subspherical to ovate-oblong, 9.8–14.4 $\times$ 4.8–7.2 μ.

On leaves of *Croton lucidus* L. in Porto Rico: Guanica, *325* (type).

14. PHYLLOSTICTA CISSICOLA Speg. Anal. Mus. Nac. Buenos Aires III. **13**: 332. 1910

On *Cissus sicyoides* L. in Porto Rico: Vega Baja, *382;* Jajome Alta, *5633a.*

15. **Phyllosticta Stevensii** sp. nov.

Spots amphigenous, irregularly circular, 4–12 mm. in diam., sordid-white to yellowish-brown above, indefinite below, reddish-brown where appearing, margin distinct, irregular, dark-brown; pycnidia epiphyllous, numerous, dark-brown, spherical to ovate, dark-bordered, 96–144 μ in diam., ostiole distinct, 24 μ in diam.; conidia hyaline, ellipsoidal, pointed at both ends, 7.2–14.4 $\times$ 2.4 μ.

On leaves of *Triumfetta semitriloba* Jacq. in Porto Rico: Coamo, *119,* (type); Villa Alba, *94.*

16. **Phyllosticta borinquensis** sp. nov.

Spots amphigenous, numerous, yellowish-brown in the center, becoming darker nearer the margin, circular to ovate, 2–5 mm. in diam., margin rather irregularly angular; pycnidia epiphyllous, scattered, dark-brown, spherical, regular, 48–70 μ in diam., ostiole dark-bordered, 12 μ in diam.; conidia hyaline, ovate, 2.4–4.8 $\times$ 1.2–2.4 μ.

On leaves of *Helicteres jamaicensis* Jacq. in Porto Rico: San German, *5672* (type).

Associated with this is one of the Sphaeriaceae, with dark-brown, spherical perithecia, 96–120 μ in diam. A mycelium of brown hyphae seems to connect the perithecia and pycnidia; asci stalked; spores eight in an ascus, septate, ovate, olivaceous, 4.8–7.2 $\times$ 2.4 μ. Owing to the fact that the spores were immature, it

was impossible to determine the genus with any degree of certainty.

17. **Phyllosticta bixina** sp. nov.

Spots yellowish-brown, scattered, subcircular to irregular, 5–10 mm. in diam., numerous, amphigenous, lighter below, often bordered by an intermediate yellow region which spreads over the leaf, older portions of the spot bordered by a distinct brownish-black margin; pycnidia few, epiphyllous, spherical, dark-brown, 92–148 μ in diam., ostiole distinct, dark-bordered, 12–24 μ in diam.; conidia hyaline, ovate, 4.8–6 $\times$ 2.4 μ.

On leaves of *Bixa orellana* L. in Porto Rico: Maricao, *174* (type); San German, *5794;* Rosario, *4844;* Mayagüez, *298;* Coamo, *53;* Punta Santiago, *2458;* Añasco, *3208;* Adjuntas, *4975a.*

18. PHYLLOSTICTA EUPATORICOLA Kab. & Bub. Hedwigia **46**: 288. 1907

On *Eupatorium odoratum* L. in Porto Rico: Villa Alba, *103.*

19. **Phyllosticta Eugeniae** sp. nov.

Spots amphigenous, circular, 2–4 mm. in diam., somewhat darker above than below, the center dark-brown surrounded by a lighter colored ring which is bordered by an even, dark, slightly elevated margin, centers falling out with age, leaf around the spot reddish-brown; pycnidia more numerous on the upper surface, dark-brown, spherical to ovate, 84–144 μ in diam.; conidia ovate, hyaline, granular, often remaining attached to their stalks, 9.6–16.8 $\times$ 4.8–6 μ.

On leaves of *Eugenia buxifolia* (Sw.) Willd. in Porto Rico: Mona Island, *6230* (type), *6091,* and *6127.*

An ascomycete is associated with this species. Perithecia amphigenous, dark-brown to black, spherical, regular, dark-bordered, 168–228 μ in diam., ostiole often opening laterally; spores hyaline, immature.

20. **Phyllosticta araliana** sp. nov.

Spots amphigenous, yellowish-brown, circular to ovate, 4–8 mm. in diam., bordered by a dark-brown, regular margin; pycnidia scattered, epiphyllous, spherical, 24–48 μ in diam., dark-

brown; conidia hyaline, ovate, slightly pointed at one end, 7.2–9.6 × 2.4 μ.

On leaves of *Dendropanax arboreum* (L.) Dec. & Pl. in Porto Rico: Maricao, *755* (type).

21. PHYLLOSTICTA GUAREAE P. Henn. Hedwigia **41**: 113. 1902.

On *Guarea trichiloides* L. in Porto Rico: Aquas Buenas, *295*.

22. **Phyllosticta Sechii** sp. nov.

Spots amphigenous, irregular or confluent, varying from 2 to 15 mm. in diam., sordid-white above, darker below, margin distinct, slightly raised, concolorous; pycnidia epiphyllous, numerous, dark-brown, spherical, 72–96 μ in diam., ostiole distinct, dark-bordered, 24–48 μ in diam.; conidia hyaline, ovate, slightly pointed at one end, 7.2–9.6 × 2.4 μ.

On leaves of *Sechium edule* (Jacq.) Sev. in Porto Rico: Mayagüez, *3357* (type).

This species differs from *Phyllosticta Lagenariae* Passer in the size and shape of the conidia, these being described as oblong, rounded at the ends, 10–12.5 × 5 μ.

23. PHYLLOSTICTA GLAUCISPORA Delacr. Bull. Soc. Myc. Fr. **9**: 216. 1893

On leaves of *Urechites lutea* Britton in Porto Rico.

In our specimens the spores are somewhat larger than those of typical specimens, measuring 4.8–9.6 × 2.4 μ. *Phyllosticta nericola* has hyaline spores, 8–10 × 3 μ, and differs only in color and a slight variation in the size of the spore. This species is distinct from *Phyllosticta Nerii* in the size of spores, those being much larger, 15–18 × 5–6 μ.

Associated with this is an undescribed species of *Colletotrichum* having perithecia surrounded with setae, and with hyaline, ovate-oblong spores.

24. PHYLLOSTICTA IPOMOEAE Ellis & Kellerman, Jour. Myc. **3**: 102. 1887

On *Exogonium repandum* (Jacq.) Choisy in Porto Rico: Manati, *5313;* Mayagüez, *20;* Rio Piedras, *5772;* Dos Bocas below Utuado, *6600*.

25. **Phyllosticta pandanicola** sp. nov.

Spots amphigenous, scattered over the leaf, grayish-white to light-brown, margin slightly darker; pycnidia located mostly along the nerves, epiphyllous, numerous, spherical to ovate, 80–100 × 50–60 μ., dark-brown, ostiole definite; conidia elliptical, pointed at both ends, hyaline, 96–144 × 2.4–3.6 μ.

On leaves of *Pandanus* sp. indet. in Porto Rico: Santurce, *240* (type).

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FUNGI EDIBLE AND POISONOUS

WILLIAM A. MURRILL

An article on this subject prepared by the writer appeared nearly a year ago in the fourth volume of the second edition of "Wood's Reference Handbook of the Medical Sciences." The plan of the article included a general introduction to edible and poisonous mushrooms; a list of edible mushrooms selected by Dr. Peck after nearly fifty years' experience; preparing and cooking mushrooms; descriptions of edible and poisonous species; and a brief glossary containing the technical terms used. In addition to the 23 pages of descriptive matter, 26 species are illustrated with ordinary half-tones and 22 with colored half-tones.

The edible and poisonous species described in this paper are carefully selected with special reference to their economic use or their dangerous properties. A number of species are omitted because they might be confused with poisonous species. Following the scientific description in each instance, are notes calling attention to special characteristics, occurrence, methods of cooking, etc.

No attempt is made to prepare a key to the species, since reliable keys are possible only when all the known plants of a group or of a region are included. The arrangement of the species follows the lines of classification adopted by the best authorities.

LIST OF SPECIES DESCRIBED

Morchella esculenta Pers. Edible
Clavaria flava Schaeff. Edible
Hydnum repandum L. Edible
Hydnum Caput-ursi Fries. Edible
Fistulina hepatica (Huds.) Fries. Edible
Grifola frondosa (Dicks.) S. F. Gray. Edible
Laetiporus speciosus (Batt.) Murrill. Edible
Tylopilus felleus (Bull.) P. Karst. Inedible
Ceriomyces crassus Batt. Edible

Ceriomyces scaber (Bull.) Murrill. Edible
Ceriomyces ferruginatus (Batsch) Murrill. Poisonous
Ceriomyces miniato-olivaceus (Frost) Murrill. Poisonous
Suillellus luridus (Schaeff.) Murrill. Poisonous
Rostkovites granulatus (L.) P. Karst. Edible
Strobilomyces strobilaceus (Scop.) Berk. Edible
Chanterel Chantarellus (L.) Murrill. Edible
Chanterel aurantiacus (Wulf.) Fries. Doubtful
Lactaria deliciosa (L.) Fries. Edible
Lactaria lactiflua (L.) Burl. Edible
Lactaria piperata (L.) Pers. Edible
Russula Mariae Peck. Edible
Russula emetica Fries. Poisonous
Russula virescens (Schaeff.) Fries. Edible
Russula foetens Pers. Poisonous
Marasmius oreades (Bolt.) Fries. Edible
Pleurotus sapidus Kalchb. Edible
Clitocybe multiceps Peck. Edible
Clitocybe illudens (Schw.) Sacc. Poisonous
Melanoleuca personata (Fries) Murrill. Edible
Armillaria mellea (Vahl) Quél. Edible
Lepiota procera (Scop.) Quél. Edible
Lepiota americana Peck. Edible
Lepiota naucina (Fries) Quél. Edible
Chlorophyllum Molybdites Massee. Poisonous
Vaginata plumbea (Schaeff.) Murrill. Edible
Vaginata agglutinata (Berk. & Curt.) O. Kuntze. Poisonous
Venenarius phalloides (Fries) Murrill. Deadly poisonous
Venenarius muscarius (L.) Earle. Deadly poisonous
Venenarius cothurnatus (Atk.) Murrill. Poisonous
Venenarius spretus (Peck) Murrill. Poisonous
Venenarius solitarius (Bull.) Murrill. Poisonous
Venenarius rubens (Scop.) Murrill. Edible
Venenarius Caesareus (Scop.) Murrill. Edible
Pleuropus abortivus (Berk. & Curt.) Murrill. Edible
Pluteus cervinus (Schaeff.) Fries. Edible
Paxillus involutus (Batsch) Fries. Edible
Inocybe infida (Peck) Earle. Poisonous
Pholiota candicans (Bull.) Schröt. Edible
Hypholoma appendiculatum (Bull.) Quél. Edible
Hypholoma perplexum (Peck) Sacc. Edible
Agaricus campester L. Edible
Agaricus placomyces Peck. Edible
Agaricus arvensis Schaeff. Edible
Coprinus micaceus (Bull.) Fries. Edible
Coprinus atramentarius (Bull.) Fries. Edible
Coprinus comatus (Muell.) Fries. Edible
Lycoperdon gemmatum Batsch. Edible
Lycoperdon cyathiforme Bosc. Edible

Scleroderma aurantium (L.) Pers. Inedible
Dictyophora duplicata (Bosc) Ed. Fisch. Considered poisonous

PREPARING AND COOKING MUSHROOMS

The following directions are given in this article for preparing and cooking mushrooms:

Reject old specimens or those infected with insects, cut off the stems except in rare cases when they are unusually tender, peel a few kinds that seem to require it, wash quickly in cold water, drain and keep in a cool place until ready to cook. As a rule, mushrooms cannot be kept very long in a fresh condition, and this is particularly true of certain very desirable species. When more are collected than can be used at once, it is best to boil them ten minutes, drain, keep in a cool place, and finish the cooking next day as desired. If allowed to stand in water, the flavor is impaired; also, peeling may remove some of the best flavored parts.

The flavor and digestibility of mushrooms depend very largely on the way they are cooked. Tender varieties should be cooked quickly and served at once; tough varieties require long, slow cooking. When the flavor is good, it should be retained by covering during the cooking process and seasoning in a simple way. When the flavor is poor or when the specimens are slightly bitter or otherwise objectionable in the raw state, they may often be greatly improved by boiling for a short time and throwing the water away, then cooking thoroughly and seasoning well. It is often desirable to mix a few highly flavored specimens with those lacking flavor. Mushrooms are also excellent cooked with meat, poultry, oysters, tomatoes, or sweet peppers, and as a flavoring for soups and sauces.

Detailed directions for cooking mushrooms are given in most of the books. The most practical and successful methods resolve themselves into broiling, baking, and stewing. In the first, which I prefer to all other methods, the mushrooms are cooked thoroughly but as quickly as possible, on both sides over a hot fire; seasoned with pepper, salt, butter, and perhaps small bits of toasted bacon; and served hot on toast. To bake mushrooms, line the pan with toast, add the specimens, season, pour in half a cup of cream, cover closely, and bake rather slowly for fifteen

minutes or more according to quality. In stewing, the mushrooms are boiled in water until thoroughly cooked, then seasoned, thickened, and served on toast. This last method is often used for the tougher or poorer varieties. Certain modifications of the above methods may be suggested later under individual species requiring special treatment.

NEW YORK BOTANICAL GARDEN.

NEWS, NOTES, AND REVIEWS

"Western Polypores," by W. A. Murrill, was issued March 25, 1915. It contains descriptions of the pileate species occurring in California, Oregon, British Columbia, and Alaska, together with descriptive notes and complete keys to the genera and species. *Polyporus McMurphyi, Polyporus Zelleri, Inonotus Leei, Pyropolyporus Abramsianus,* and *Elfvingia Brownii* are described as new, while *Scutiger hispidellus* (Peck) and *Fomes amarus* (Hedgcock) are newly combined. *Crytoporus volvatus* appears in this work as the only representative of a new tribe, the Volvatae, characterized by the presence of a volva. The polyporaceous flora of the Pacific coast has been until recently very imperfectly known, and much field work still remains to be done in many parts of the region.

A paper on the Polyporaceae of Wisconsin, by J. J. Neuman, containing 156 pages of text and 25 plates, has just appeared as Bulletin 33 of the Wisconsin Geological and Natural History Survey. The family is treated in the broadest Friesian sense, including *Solenia, Porothelium, Merulius, Glocoporus, Fistulina,* and the Boletaceae, in addition to the true polypores. The brief descriptions of species are accompanied by quite complete and helpful notes on habitat, occurrence, and relationship. Several introductory pages are specially devoted to species destructive to timber trees in the Wisconsin forests. Of the true polypores, over one hundred are recorded for the state. The author proposes one new variety, *Fomes nigricans populinus,* which might better have been based on *Fomes igniarius.* The plates add to the value of the work for purposes of identification, although most of them are, unfortunately, rather poor reproductions.

Russula and Marasmius in North American Flora

Volume 9, part 4, of *North American Flora,* by Gertrude S. Burlingham, William A. Murrill, and Leigh H. Pennington, ap-

peared April 30, 1915. The contents of the part may be indicated as follows:

Genera	Total Species	New Species
Russula	115	17
Schizophyllus	1	
Pleurotopsis	5	1
Scytinotus	3	1
Resupinatus	13	3
Marasmiellus	3	2
Panellus	10	3
Tectella	1	
Heliomyces	12	10
Marasmius	153	48
Polymarasmius	3	1
Crinipellis	7	4
Lentinus	18	2
Lentinula	1	
Lentinellus	1	
Lentodium	2	
	348	92

For the accommodation of those preferring currently accepted generic names, the following new combinations are proposed for species described as new in *Pleurotopsis, Scytinotus, Resupinatus, Marasmiellus, Panellus, Polymarasmius,* and *Crinipellis:*

PLEUROTOPSIS NIDULIFORMIS = **Marasmius niduliformis**
SCYTINOTUS DISTANTIFOLIUS = **Marasmius distantifolius**
RESUPINATUS CUBENSIS = **Pleurotus cubensis**
RESUPINATUS SUBBARBATULUS = **Pleurotus subbarbatulus**
RESUPINATUS ORIZABENSIS = **Pleurotus orizabensis**
MARASMIELLUS INCONSPICUUS = **Marasmius inconspicuus**
MARASMIELLUS JUNIPERINUS = **Marasmius juniperinus**
PANELLUS JALAPENSIS = **Panus jalapensis**
PANELLUS SUBCANTHARELLOIDES = **Panus subcantharelloides**
PANELLUS FLABELLATUS = **Panus flabellatus**
POLYMARASMIUS SUBMULTICEPS = **Marasmius submulticeps**
CRINIPELLIS SUBLIVIDA = **Marasmius sublividus**
CRINIPELLIS ALNICOLA = **Marasmius alnicola**
CRINIPELLIS SQUAMIFOLIA = **Marasmius squamifolius**
CRINIPELLIS ECHINULATA = **Marasmius echinulatus**

The largest tribe of the Agaricaceae, the Agariceae, is divided into four subtribes: the Lepiotanae, or white-spored series; the

Pluteanae, or rosy-spored series; the Pholiotanae, or rusty-spored series; and the Agaricanae, in which the spores are brown or black in mass. Two new genera are included, *Marasmiellus* and *Polymarasmius*, each with three species. Another new genus of the Lepiotanae, *Lentodiellum*, containing a single tropical species, occurs in the key but the description had to be reserved for the first page of Volume 9, part 5.

W. A. MURRILL.

THE VALIDITY OF CLITOCYBE MEGALOSPORA

The writer has recently had an opportunity to examine the type specimen of *Clitocybe megalospora* Clements (Bot. Surv. Neb. 4: 18. 1896), which was collected on wet earth at Saltillo, Nebraska, July 7, by Pound and Clements (No. 4239); and he was surprised to find it identical in every respect with four collections obtained by him several years ago in Virginia, Tennessee, and Pennsylvania. The description of *Clitocybe megalospora* corresponds to that of *Collybia radicata*, the lamellae being described as white or yellowish and the spores as hyaline and very large, reaching 17–18 × 10–12 μ. The plants collected by the author in Virginia and elsewhere were in each case determined when fresh as undoubtedly *Collybia radicata* and the accompanying field notes described them as sticky when moist, white, with yellowish center and white lamellae.

It was not until several years later, when these specimens were examined in the herbarium, that the lamellae were found to be brick-red and a microscopic mount from the lamellae apparently showed a mycelium bearing enlarged red tips rounded off at the apex, which seemed to become constricted and separate as spores. It is difficult to make a microscopic study of this kind from dried material, and further study was deferred with the hope that additional material might be found in the fresh state. The type of *C. megalospora* upon microscopic examination showed the same reddish bodies and the lamellae were partly colored red by them. It is possible that we have here an interesting microscopic organism which changes the color of the lamellae, but why this occurs after the specimen is collected and dried is not so clear. Many of the rosy-spored gill-fungi have whitish lamellae

when fresh, and these become rose-colored on drying from the mature rose-colored spores. It is hoped that collectors during the coming season will be on the lookout for plants of "*Collybia radicata*" that turn red on the under side in drying.

W. A. MURRILL.

THE TWENTIETH ANNIVERSARY OF THE NEW YORK BOTANICAL GARDEN

The twentieth anniversary of the appropriation by the City of New York of 250 acres of land in Bronx Park for the use of the New York Botanical Garden will be commemorated at the Garden during the week commencing September 6, 1915. Botanists from all parts of North America are invited to attend. The following program is planned; and other excursions, of more special character, may be arranged if opportunity offers.

Monday, September 6

10–1:30. Assemble at the Garden as convenient
1:30. Lunch at the Garden
2:30. Addresses of welcome and an account of the history of the Garden
3:30–5:30. Inspection of a portion of the grounds and buildings
5:30–7:00. Visit to Zoological Park

Tuesday, September 7

10:30–1:00. Session for the reading of papers
1:30. Lunch at the Garden
2:30–4:00. Session for the reading of papers
4:00–6:00. Inspection of portions of the buildings and grounds

Wednesday, September 8

Salt Water Day on Staten Island for a study of the coastal flora
Lunch at 1:30 with subsequent opportunity for scientific oratory

Thursday, September 9

10:30–1:00. Session for the reading of papers
1:30. Lunch at the Garden
2:30–4:00. Session for the reading of papers
4:00–6:00. Inspection of portions of the grounds and buildings

Friday, September 10

Visit to the pine barrens of New Jersey under the guidance of the Torrey Botanical Club

Saturday, September 11

Visit to the Brooklyn Botanic Garden and an excursion to some Long Island locality

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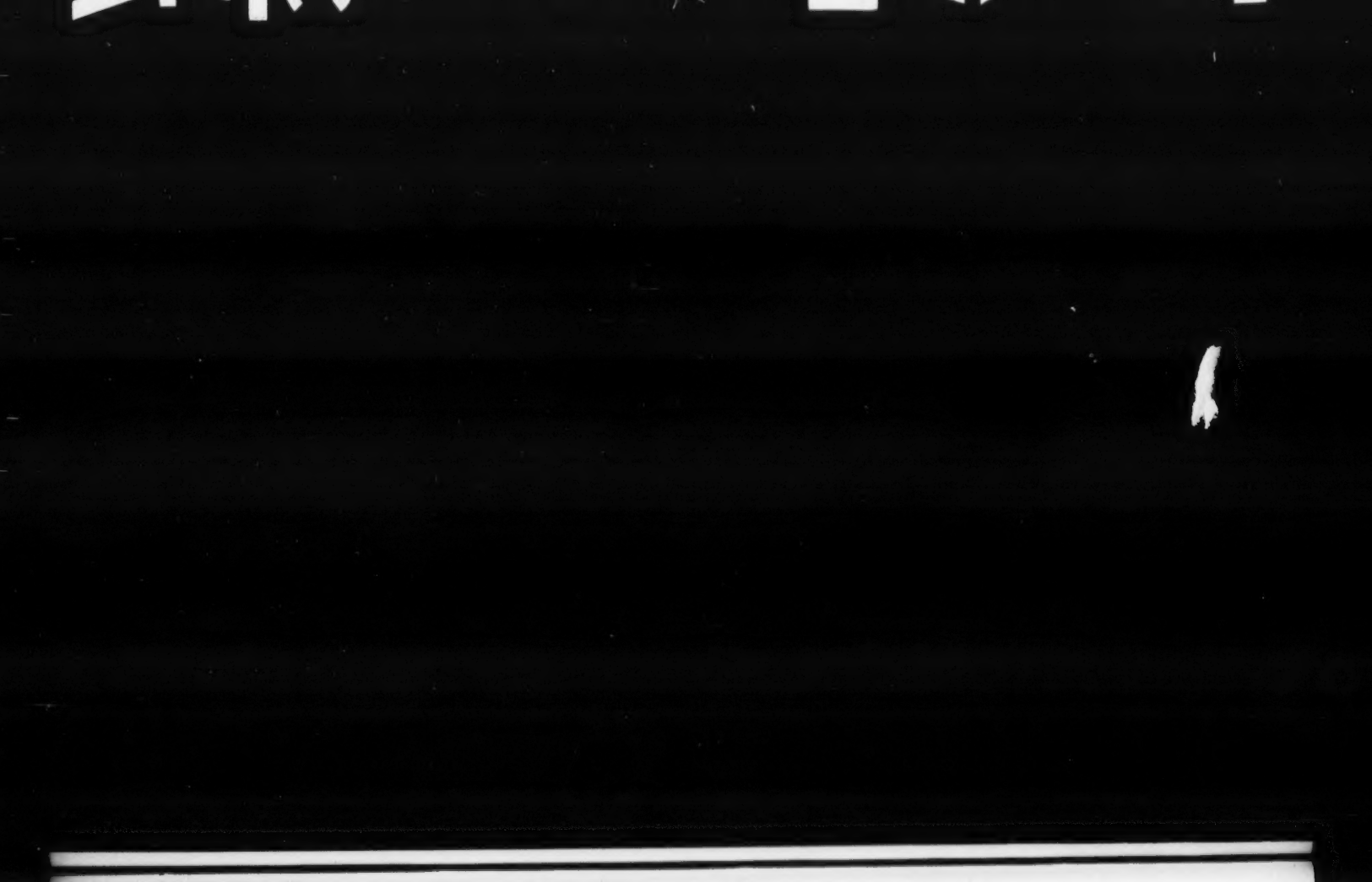
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